Integration by parts - Undo product rule

$$\int u \cdot dv = uv - \int v\,du$$

Evaluate $\int x \cos x \, dx$

$$\int u\,dv = uv - \int v\,du$$

$u = x$ $dv = \cos x\,dx$

$\frac{du}{dx} = 1$ $v = \sin x$

$du = dx$

$$= \underset{u \cdot v}{x \sin x} - \int \underset{v \cdot du}{\sin x\, dx}$$

$$= x\sin x + \cos x + C$$

Check answer:
take a derivative

$x\cos x + \sin x - \sin x$

$x \cdot \cos x$

Evaluate $\int xe^x \, dx$

$$\int u\,dv = uv - \int v\,du$$

$u = x$ $\quad$ $dv = e^x dx$

$du = dx$ $\quad$ $v = e^x$

$$xe^x - \int e^x \, dx$$

$$xe^x - e^x + C$$

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Evaluate $\int_1^3 \ln x \cdot dx$

$$\int u\,dv = uv - \int v\,du$$

$$u = \ln x;\quad dv = dx$$

$$du = \frac{1}{x}dx;\quad v = x$$

$$= x \cdot \ln x - \int x \cdot \frac{1}{x}\,dx$$

$$= x \cdot \ln x - \int dx$$

$$= (x\ln x - x)\Big|_1^3 = (3\ln 3 - 3) - (\ln 1 - 1)$$

$$3\ln 3 - 3 + 1$$

$$* \quad 3\ln 3 - 2$$

$$* \quad \ln 27 - 2$$

Evaluate $\int x^2 \cos x \, dx$

$$\int u\,dv = uv - \int v\,du$$

$u = x^2 \qquad dv = \cos x\,dx$

$du = 2x\,dx \qquad v = \sin x$

$$x^2 \sin x - \int 2x \sin x\,dx$$

$$x^2 \sin x - 2\underbrace{\int x \sin x\,dx}$$

$u = x \qquad dv = \sin x\,dx$

$du = dx \qquad v = -\cos x$

$$x^2 \sin x - 2\left[-x\cos x - \int -\cos x\,dx\right]$$

$$x^2 \sin x - 2\left[-x\cos x + \sin x\right]$$

$$x^2 \sin x + 2x\cos x - 2\sin x + C$$

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$$\int x^5 \cos x \, dx$$

u	dv
x^5	$\cos x$
$5x^4$	$\sin x$
$20x^3$	$-\cos x$
$60x^2$	$-\sin x$
$120x$	$\cos x$
120	$\sin x$
0	$-\cos x$

$$x^5 \sin x + 5x^4 \cos x - 20x^3 \sin x - 60x^2 \cos x$$
$$+ 120x \cdot \sin x + 120 \cos x + C$$

$\int x^2 e^{x^3}\,dx$

$u = x^3$

$du = 3x^2\,dx$

$\frac{1}{3}\int 3x^2 e^{x^3}\,dx$

p 431
1-27 odd

$\frac{1}{3}\int e^u\,du$

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